Symposium on Science and Industry

Karl T. Compton

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SCIENCE AND INDUSTRY

A LITTLE over a year ago it was suggested that something might be done to encourage further interest in science on the part of industrial leaders through their own National Association of Manufacturers. Several officers of the American Institute of Physics accordingly approached the president of that association with a carefully prepared project designed to point out that industries depend for their future prosperity, and even survival, on the trends of science as much or more than on trends in governmental regulation, labor relations and other social factors. This is the indication of the past but the fact is frequently overlooked. The result of this interview was the formation of a joint "Science Committee" of the two organizations of which Dr. Elon H. Hooker, president of the Hooker Electrochemical Company, is chairman.

After considerable discussion, the committee adopted a program whose guiding principle is that a direct exchange of ideas between leaders of science and of industry is valuable. It is felt that this is one relationship not provided in other ways, as for example through industrial research laboratories. It was the committee's expectation that only broad general aspects and trends of science could be discussed, with possibly some observations, from the scientists' point of view, on the social effects of scientific progress.

The program will take the form of addresses at conventions of the Manufacturers' Association and supplementary printed reports to its members. The first "science program" has now been held. It was a part of the annual American Congress of Industry sponsored by the Association which recently convened in New York. On the afternoon of December 8 the Congress was addressed by Dr. Karl T. Compton who spoke on the objectives of the program, by Dr. Edward R. Weidlein on "Chemical Research Affecting Industry" and by Dr. Robert A. Millikan on certain aspects of science and its influence on civilization with special reference to the science of physics.

We publish herewith Dr. Compton's address and also a report made by Dr. Hooker at the close of the science program.

HENRY A. BARTON

Symposium on Science and Industry*

Karl T. Compton

President, Massachusetts Institute of Technology

IN the creation of industrial prosperity and high standards of living the part of science is well known. Many figures have been quoted to prove it. Industries like the automobile, communication, chemical, public utility, railroad and modern food industries stand out as examples of what science can do in creating employment and profits and socially useful products. A few years ago the president of the General Electric Company reported that 60 percent of the business of his company in that year came from products which were unknown 10 years previously. Principally since the Great War the duPont Company has been transformed by research from an industry dealing almost exclusively in explosives into one in which 99 percent of the business is in new products which are used in the affairs of everyday life rather than in warfare. The president of this company gave you yesterday a magnificent vision of what industry can do to solve our most pressing national problem, and outlined the fundamental conditions which can bring this solution and vision into a reality. His own company is one of those which has most convincingly demonstrated just how this can be done, through careful planning and forward-looking scientific development.

Research in pure science, followed by invention and engineering development, have produced these results. This has flourished in an atmosphere of individual initiative, use of capital and relative freedom from bureaucratic restrictions imposed by government. Nothing is more certain than that science and engineering can accomplish similar miracles of social and industrial progress in the future if given similar financial support in the same democratic atmosphere of freedom of initiative and if business has freedom from oppressive governmental policies that threaten to tear down the house in order to clean up a few dirty spots in the carpet.

* Address before the National Association of Manufacturers, December 8, 1937, New York City.

A recent discussion of such matters by a few members of the National Association of Manufacturers and the American Institute of Physics led to the formation of a joint committee of manufacturers and scientists under the chairmanship of Dr. Elon Hooker. It is the purpose of this committee to foster those conditions under which science may be of best service to our country, with particular reference to its relationship to the manufacturing industries. It is under the auspices of this committee that my colleagues, Dr. Robert A. Millikan and Dr. E. R. Weidlein are speaking in this symposium on science and industry.

Science finds two general types of industrial application: the one is to increase efficiency in production, and the other is to develop new products and new industries. The former of these has received much attention in the popular mind in the last half-dozen years through talk of technological unemployment and the discussions of technocracy. All through the ages men have sought applications of science in order to diminish the burden and increase the productiveness of human labor. Our very civilization is based on the success which has attended this continual effort to find ways of doing things more easily and more effectively.

As an unfortunate by-product of technological progress, unemployment does frequently occur in individual situations following the introduction of labor-saving machinery, and the public attention focused on these circumstances has detracted attention from the far more important role of science in the creation of new industries and new employment. There is a real danger that emotional and uninformed reaction to those instances in which men have temporarily lost employment may lead to legislation or restrictions, or to lack of public sympathy with scientific work, which will inhibit the greater service of science in the creation of new employment. This would be a major disaster. It is no protection to the working man to pass legislation which will insure him his job for the present but which will make his employment impossible in the future. It is therefore highly important that our political and industrial leaders should recognize the fact that progress and prosperity come not through restrictions but through stimulation and encouragement. I believe that this is a general law of nature, applicable generally as well as to scientific work in particular.

There is no necessity for making a plea to manufacturers in behalf of that type of scientific work which is aimed at increased efficiency of production. The manufacturer's own self-interest takes care of this aspect of science. There is real point, however, in urging manufacturers to foster that type of scientific work which is not aimed at increasing efficiency of present operations, but which has the long-range aim of creating entirely new products and new business at some undefined time in the future. Manufacturers need encouragement and faith to support this type of scientific work because they are not forced to do it by the current year's budget. It is an activity which can probably be omitted with a gain rather than a loss in the financial report of the current year. But all logic and experience indicate that this type of scientific work is the ultimate salvation of an industry, and it is even more true today than it was 300 years ago when Francis Bacon wrote: "That which man altereth not for the better, Time, the Great Innovator, altereth for the worse."

The results of scientific research are to a considerable extent unpredictable. The more fundamental and forward-looking the research is, the more unpredictable are its results. The only thing which can be predicted with full assurance is that on the average research work pays large dividends.

We may define the proper scope of scientific research in industry as that which shows reasonable promise of producing better products or desirable new products which can be made and sold with profit, or of reducing the cost of existing products. It is therefore quite reasonable for an industrial organization to conduct research which has a specific goal of economic interest to the industry with reasonable expectation of early results. This is therefore the type of research usually found in industrial laboratories. It is very important, and it also is supported by the self-interest of every enlightened manufacturer.

But what is to be done with the more fundamental and far-reaching research whose end is not in sight? This is variously designated as pure research or academic research or theoretical

research. It is this type of research which is likely to have the most important ultimate consequences. But these consequences may prove to be quite out of line with the business of any given organization which may be conducting the research. Just as the promoters of the early expeditions to explore America were seeking a trade route to China but discovered a great new continent, just so the promoter of a very fundamental research to develop a new method of transmuting atoms may discover an improved method for the treatment of cancer, or conversely the man who starts out to develop a chemical for medicinal purposes may discover a new industrial use of a farm product.

The fact is that each individual industrialist needs the results of fundamental scientific work but may not feel justified in conducting such work in his own organization because of the unpredictability of the results. The answer to this dilemma, from the point of view of the industrialist's own self-interest, appears to be that most fundamental research must continue to be conducted where it is now being done, in the universities and other nonprofit scientific institutions including bureaus of the government. A further conclusion is that this work must receive its financial support from the community at large including the industrialist himself, since the ultimate benefit of this work is to the community and to the industrialist. This would be a logical argument for federal subsidy of scientific work in our educational institutions. Many of us believe that such subsidy could be a great investment in future national welfare, though we have grave doubts whether the plan could be administered with efficiency and without political domination which might entail far greater dangers than benefits.

The only alternative which I can see, which will at the same time avoid these dangers and secure the ultimate benefits of fundamental science in industry, is a widespread support of scientific work in our educational institutions by industry and industrialists. In this manner the risks due to unpredictability of results are shared and all have a free and equal opportunity to use and benefit by the scientific progress which is made. Perhaps there is possible a combined effort of government and private industry through an encouragement to support of research in and by industry by special tax reduction or other benefit for industrial expenditures for research,—with the idea that such rebates will ultimately be far more than recovered through taxation of the profits on the new business which will be created by the research.

Finally, I would emphasize the fact that time is required to pass from initial scientific study to ultimate industrial application in the manufacture of a product. Scientific ideas, like seeds, require time to germinate; inventions, like plants, flourish only with cultivation and require time to ripen before they can be harvested.

We must not overlook this time element, or the fact that new discoveries and new industries cannot be pulled like rabbits out of a hat. They require systematic preparation and orderly development. This is a fact which it was hard for some of our political leaders to grasp during the depression when there was a tendency to blame the scientists for not being able immediately to produce out of their hats, or out of the brains beneath their hats, some new industries which would solve the unemployment problem. The real point was that the results of their past work were already being absorbed into the industrial world as rapidly as their development permitted and if additional industries based on science had been desired in the year 1933 the seeds should have been sown and nurtured through increased financial support of scientific work beginning at least a decade earlier.

We have had relatively few scientifically trained political leaders. George Washington was an engineer. Thomas Jefferson was an architect and a scientist. Herbert Hoover was an engineer. Several years before his election to the presidency, Hoover had worked actively to promote greatly increased industrial support of pure science, and I firmly believe that, had this program not been engulfed by the depression, it would today constitute the most important move which has been made in the direction of insuring industrial prosperity with new wages and new profits in the years which are ahead.

With these introductory remarks on some of the important considerations which underlie the successful use of science to promote our national welfare, I will pass the discussion on to my col-

leagues, Doctors Millikan and Weidlein, who will amplify these remarks along the lines of their special fields of interest in the subject. It is the hope of our joint committee, which represents your interest in science, that we may serve you by supplying you with useful information on the developments, trends and conditions of science in its relations to industry.

Report of Science Committee to the National Association of Manufacturers*

Elon H. Hooker

President, Hooker Electrochemical Company

IT has been said one cannot see the forest on account of the trees. There are new trends in science which, as the generations pass, shake a quiet industrial world to its foundations, create new industries and pass old ones into oblivion. We manufacturers are submerged today in problems of avoiding increase to the forces of depression. Hopefully tomorrow we may be limiting to moderate expansion the ambitious productive facilities then called for by an over-insistent and hysterical demand. How, then, amid these distractions, shall we busy executives see the broader handwriting on the wall, sense approaching fundamental change, be quick to steer our bark toward a new port and be advised of the shoals while there is yet time.

The distinguished speakers of this afternoon have, I am sure, pointed out to you the sudden jolts and interruptions to the stream of applied science as it flows down the corridors of time.

The ages of *man* power were first directed in mystery, then in pure philosophy and finally passed through that period of delusion, pestilence and suffering known as the Middle Ages when art was exalted but science was ridiculed, feared and fought. Then came the beginnings of reason and the advent of modern times. The creative mind began to an increasing extent to have some control over the forces of nature. Thereafter has come the age of steam, of electricity, and now biology, physics and chemistry are beginning to join hands in the great unknown. From this union there are glimmerings of the dawn of new adventures.

They can only fructify to the benefit of mankind through pure science passing on ideas to be fashioned into useful things desired by an educated civilization and manufactured through the processes of the industrial world.

We manufacturers have our own research organizations, greater or smaller according to our need or our enlightenment, but practical executives are under pressure to keep their efforts localized on home problems and on what will presently yield a dividend. Perhaps we are not seeing the forest for the trees.

It is some such thought which brought the American Institute of Physics and the National Association of Manufacturers together. Each has appointed plenipotentiaries to arrange a closer union—a sort of trial marriage between the principals who create these adventures and those of us in the realm of industry who undergo them and suffer the violent shocks engendered by their advent into modern society. For such a joint committee, including the representatives of the National Association of Manufacturers and the American Institute of Physics, I have the honor to report in practical fashion through the program of this afternoon. We are hopeful that you will find in it the germs of something vital both to pure science and to industry and will order your joint committee to form a more perfect union and ensure domestic tranquillity.

* Presented December 8, 1937, at its convention in New York.